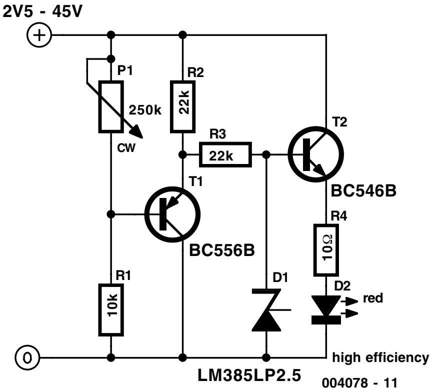
013

Simple Voltmeter



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This circuit provides a simple means to determine the voltage of a low-impedance voltage source. It works as follows. P1, which is a 1-W potentiometer, forms a voltage divider in combination with R1. The voltage at their junction is buffered by T1, and then passed to reference diode D1 via R3. D1 limits the voltage following the resistor to 2.5 V. An indicator stage consisting of T2, R4 and LED D2 is connected in parallel with D1. As long as the voltage is not limited by D1, the LED will not be fully illuminated. This is the basic operating principle of this measurement circuit.

If you rotate P1 from its maximum setting towards the minimum until the LED is fully illuminated, you know that the voltage is limited by D1 at this setting, and that the voltage across D1 is exactly 2.5 V. The voltage across R1 is then equal to $(U_{D1} - U_{BE1}) = (2.5 - 0.5)\ V = 2\ V$. This means that you have used P1 to set the voltage across R1 to 2 V. Based on this, you can determine the input voltage as follows. The voltage across R1 is given by:

$$U_{R1} = \frac{R1}{R1 + \alpha \cdot P1} \cdot U_{in}$$

From this, it follows that the input voltage is:

$$U_{in} = \left(1 + \frac{\alpha \cdot P1}{R1}\right) U_{R1}$$

You can see that U_{in} is nearly equivalent to the amount of rotation of P1. All you have to do to complete the voltmeter is to provide a scale for P1. You can calibrate the scale by connecting a real voltmeter in parallel with the circuit and varying the input voltage.

The current consumption of this circuit is approximately 8 mA. The voltage source to be measured must be able to easily supply this current, since otherwise the voltage will drop too much during the measurement.

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